



Agilent E7450B and E7452A RF Coverage Measurement Systems

Data Sheet



The Agilent Technologies E7450B and E7452A RF coverage measurement systems are used to obtain comprehensive RF measurement data versus location to assess the coverage of wireless communications networks using IS-95 and J-STD-008 CDMA technologies. A PC interfaces to an Agilent digital receiver. Each system includes PC software and a digital receiver (with a cigarette lighter power adapter, an ac/dc power adapter, and an RS-232

cable). The systems can be integrated with a GPS receiver and mapping software. The E7450B system operates in the 1900 MHz band using the E6450B digital receiver, and the E7452A system operates in the 850 MHz band using the E6452A digital receiver.

Other frequency bands are available. Please consult an Agilent representative for more information.



Agilent Technologies

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System software

Receiver functionality

The systems provide four primary measurement classes:

- Spectrum analysis
- CW power
- Channel power
- CDMA pilot channel analysis

The controls listed below are available for each receiver measurement class:

Measurement interval	Averaging
<ul style="list-style-type: none">• Time• Distance	<ul style="list-style-type: none">• Running• Group• Max hold

Measurement interval defines the duration between measurements. This can be specified in terms of time (e.g., execute a measurement every 200 milliseconds) or distance (e.g., execute a measurement every 10 meters).

Multiple receiver capability

The standard Agilent E7450A and E7452A systems include one receiver. Up to four receivers can be controlled simultaneously by the system software. The systems support any combination of Agilent E6450B or E6452A digital receivers, up to a total of four. Using multiple receivers simultaneously can greatly improve drive test efficiency for applications such as those involving multiple CDMA carrier frequencies, measuring 850/1900 MHz borders, monitoring simultaneously forward and reverse links, and monitoring competitive networks.

For ordering instructions regarding multiple receivers, please refer to the *Agilent E74XX Series CDMA Drive Test Solutions Configuration Guide*.

Spectrum analysis

The spectrum display provides the controls listed below. Frequencies can be specified in terms of frequency units or channel number.

Measurement controls

<ul style="list-style-type: none">• Frequency, tunable range<ul style="list-style-type: none">• E7450B<ul style="list-style-type: none">–1850–1910 MHz–1930–1990 MHz• E7452A<ul style="list-style-type: none">–824–849 MHz–869–894 MHz• Frequency, maximum span<ul style="list-style-type: none">• E7450B<ul style="list-style-type: none">–60 MHz• E7452A<ul style="list-style-type: none">–25 MHz	<ul style="list-style-type: none">• IF bandwidth<ul style="list-style-type: none">–1.25 MHz (wideband mode)–30 kHz (narrowband mode)• Resolution bandwidth<ul style="list-style-type: none">–8.36 kHz to 1 MHz in wideband mode–246 Hz to 28 kHz in narrowband mode
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Markers

- Multiple markers
- Delta markers
- To Max function
- Drag and drop

Spectrum noise floor (characteristic):¹

	Average	Peak
Narrowband mode / 300 kHz span	–139 dBm	–131 dBm
Wideband mode / 300 kHz span	–128 dBm	–119 dBm
Narrowband mode / 25 MHz span	–132 dBm	–129 dBm
Wideband mode / 25 MHz span	–123 dBm	–117 dBm

CW power and channel power

The E7450B and E7452A can measure the peak power (**CW Power**) at user-defined frequencies within a user-defined resolution bandwidth. The systems can also measure the total power (**Channel Power**) within a user-defined bandwidth at a user-defined set of frequencies. This differs from the CW power measurement in that the total power is integrated across the specified channel width. The user can define the frequencies to be measured in two different ways.

Frequency entry methods

- List Enter an arbitrary list of frequencies.
- Trace Enter a start frequency, step size, and count. The system measures at the start frequency, at the (start + step) frequency, ..., (start + (count – 1) * step) frequency. For example, if the start frequency is set to 1900 MHz, the step size is set to 1 MHz, and the count is set to 4; then measurements are made at 1900 MHz, 1901 MHz, 1902 MHz, and 1903 MHz.

Frequencies can be specified in term of frequency units or channel number.

Measurement controls

- Frequency
 - Arbitrary list (list)
 - Start / step / count (trace)
- IF bandwidth
 - 1.25 MHz (wideband mode)
 - 30 kHz (narrowband mode)
- Resolution bandwidth (CW power only)
 - 8.36 kHz to 1 MHz in wideband mode
 - 246 Hz to 28 kHz in narrowband mode
- Channel width (channel power only)
 - E7450B
 - 8.36 kHz to 60 MHz in wideband mode
 - 246 Hz to 60 MHz in narrowband mode
 - E7452A
 - 8.36 kHz to 25 MHz in wideband mode
 - 246 Hz to 25 MHz in narrowband mode

1. Does not imply warranted performance, but rather characteristic performance. Tested with minimum resolution bandwidth: 246 Hz in narrowband mode, 8.46 kHz in wideband mode.

CDMA pilot channel analysis

The Agilent E7450B and E7452A systems are capable of measuring IS-95 and J-STD-008 CDMA pilot channels. These measurements are independent of network parameter settings. The systems execute four different types of CDMA pilot channel measurements (listed below). Any or all of them can be executed simultaneously.

Measurement types

- All pilots The system measures the power, both E_c and E_c/I_o , of all 512 pilot channels. The results are displayed as a trace with one point for each of the 512 PN offsets.
- Top N The system measures all of the pilots in the network and returns the 'N' strongest pilot channels received, where 'N' is a user definable integer from 1 to 20. The results are displayed in bar graph format.
- Zoomed pilots The user sets the center and span in terms of chips (or PN offsets). The results are displayed as a trace.
- User list The user manually inputs a list of up to 20 PN offsets to be measured. The measurements are displayed in bar graph format.

Measurement controls	Display controls
<ul style="list-style-type: none"> • Carrier frequency <ul style="list-style-type: none"> –Frequency –Channel • Measurement types <ul style="list-style-type: none"> –All pilots –TopN pilots –Zoomed pilots –User list of pilots • PN increment 	<ul style="list-style-type: none"> • Power display (Y-axis parameter) <ul style="list-style-type: none"> –E_c/I_o –E_c • Show value (bar graphs only) <ul style="list-style-type: none"> –Peak E_c/I_o –Peak E_c –Aggregate E_c/I_o –Aggregate E_c –Aggregate - peak –Delay spread –Pilot delay

Markers	Measurement results (trace displays only)
<ul style="list-style-type: none"> • Multiple markers • Delta markers • To Max function • Drag and drop 	<ul style="list-style-type: none"> • Peak E_c/I_o • Peak E_c • I_o • Aggregate E_c/I_o (TopN and user list only) • Aggregate E_c (TopN and user list only) • Aggregate - peak (TopN and user list only) • Delay spread (TopN and user list only) • Pilot delay • Carrier frequency error

Peak pilot power (both E_c and E_c/I_o) are computed by selecting the strongest peak of the correlation for each pilot. I_o is the total received power integrated across the entire 1.2288 MHz signal bandwidth.

Aggregate pilot power (both E_c and E_c/I_o) are computed for a given pilot by integrating the power received over the time dispersion of that pilot. **Delay spread** is the duration of time over which this power is dispersed. Both aggregate pilot power and delay spread are determined with respect to an E_c/I_o threshold of -17 dB. The system also reports the difference between the aggregate and peak pilot power (**aggregate-peak**). This difference along with the delay spread provides a characterization of the multipath effect on that pilot. Aggregate pilot power and delay spread are only measured for the TopN and user list measurement types.

Pilot delay is defined as the difference in time between when a pilot signal is received and when it *should* have been transmitted, as defined by GPS timing. For example, a base station transmitting PN offset 0 is expected to start a new short-code pattern synchronous with the GPS even second clock. If the signal is received 3 chips after the GPS even second clock, then the pilot delay is said to be 3 chips (1 chip ≈ 0.8 microseconds). Timing offsets can be due to both propagation delay and base station timing problems.

Carrier frequency error is defined as the difference between the measured carrier frequency and the user-specified carrier frequency. The measured carrier frequency is of the dominant pilot signal. Carrier frequency error can be due to both base station carrier error and doppler shift (if moving).

Alerts and alarms

The Agilent E7450B and E7452A have sophisticated alarming capability. An alert is defined as a single condition on a single measurement. An alarm is a boolean expression made up of multiple conditions on multiple measurements. When an alert or alarm condition occurs, any or all of the actions listed below can be executed. If the alert or alarm condition occurs while data is being logged, each data record includes the alert/alarm information.

Actions

- Play a .wav audio file
- Display a text message
- Pause or stop measurements

Alert operators

- Value
- Maximum
- Minimum

Alarm operators

- Value
- Maximum
- Minimum
- Sub-set
- OR
- AND
- XOR (exclusive OR)

Alert conditions

- Greater than (>)
- Greater than or equal to (\geq)
- Less than (<)
- Less than or equal to (\leq)
- Equal to (=)
- Not equal to (\neq)

Alarm conditions

- Greater than (>)
- Greater than or equal to (\geq)
- Less than (<)
- Less than or equal to (\leq)
- Equal to (=)
- Not equal to (\neq)
- Is a sub-set
- Is not a sub-set
- Sets intersect
- Sets do not intersect

Any measurement can be an operand in an alert or alarm. Below are some examples to illustrate alerts and alarms.

Alerts: Maximum(TopN Ec/Io) < -10 dB

Alarms: (Maximum(TopN Ec/Io) < -10 dB) AND (Io -60 dBm)

System status parameters can also be used as operands in alerts and alarms. For example, an alert can be defined to trigger when the available disk space on the PC drops below 10 MB or when the GPS position fix is lost.

System status parameters

- Available disk space
- GPS fix
- Location
- Velocity
- Percent CPU usage
- PC battery level
- PC AC power
- Time of day

Alarm wizard

Setting up alarms is fast and easy using the alarm wizard feature. Commonly desired alarms that are available via the alarm wizard are listed below.

- Pilot pollution
- No coverage
- Weak CW
- Lost GPS fix
- No location fix
- Low disk space
- Low battery
- No AC power
- High CPU usage

Data recording and playback

Logging and playback of data are controlled by VCR-like buttons. While logging data the user can enter notes into the data. Two methods of user note entry are provided. One prompts the user to enter a text string, for example, "entering a tunnel." The other automatically enters a numbered note into the database requiring minimum interaction with the keyboard. A summary of record and playback features are listed below.

Record features

- User note
- Automatically numbered note
- Display on/off
- Pause/resume

Playback features

- Play forward
- Play reverse
- Step forward
- Step reverse
- Variable speed
- Advance to alert/alarm
- Advance to user note/auto-numbered note

Data export

Data can be exported from the Agilent E7450B and E7452A databases for display and post-processing. Any measurement data can be exported. The export function provides flexible filtering capability to define the specific data to be exported. Several different operations can be executed in order to provide the desired data in the desired format.

Processing functions

- All values
- Count
- Count with summary
- Maximum
- Minimum
- Value(x)

Conditionals

- Greater than (>) a threshold
- Less than (<) a threshold
- All values
- Qualified against another measurement

Sorting

- Ascending
- Descending
- None

The output formats supported by the Agilent E7450B and E7452A are listed below. The system is designed to work with MapInfo in an integrated manner via an object link embedded (OLE) link to the MapInfo application. This exports the data, launches MapInfo, creates the necessary MapInfo tables, and creates a thematic map display in MapInfo. This functionality does require MapInfo be present. MapInfo can be purchased as Option 310 on the system or purchased separately.

Data output formats

- MapInfo OLE
- MapInfo text file
- ArcView text file
- Plain text file (no headers)
- PlaNET result
- Raw binary

Geographic binning can be applied to the data as part of the export function. Binning is a data-reduction process in which the driven area is overlaid by a grid of user-definable size, and the average of the data over each square is reported.

Agilent E6450B and E6452A receiver specifications¹

Frequency

Frequency range	
E6450B	1850–1910 MHz 1930–1990 MHz
E6452A	824–849 MHz 869–894 MHz
Frequency accuracy	± 1 ppm
with GPS time synchronization	± .05 ppm characteristic
IF bandwidth	1.25 MHz characteristic 30 kHz characteristic
Aging of TCXO	± 1 ppm/year

Amplitude

Accuracy	
1.25 MHz IF bandwidth	± 1 dB; ±0.5 dB typical (20 – 30° C, –40 to –100 dBm) ± 2 dB (0 – 55° C, –40 to –100 dBm)
30 kHz IF bandwidth	± 1.5 dB; ±0.5 dB typical (20 – 30° C, –40 to –100 dBm) ± 2.5 dB (0 – 55° C, –40 to –100 dBm)
Noise figure	8 dB typical
Internally generated spurious	–120 dBm
Maximum safe input level	+10 dBm = 20V DC characteristic
1 dB compression point	–15 dBm characteristic
Adjacent channel desensitization ²	–25 dBm typical
Adjacent channel rejection ³	45 dB typical

Input/output

RF input	50Ω type-N
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Connectors

Computer	RS-232 (DB9) Male
GPS	RS-232 (DB9) Male
Power	DC power jack 100 mils, positive center

Misc

Operating temperature range	0 to 55° C
Storage temperature range	–40 to 70° C
Dimensions	6 in x 3 5/8 in x 8 3/4 in
Weight	4.5 lbs
Power	9–34 V DC, 9W
with Option 200	9–34 V DC, 10W

1. Specifications describe warranted performance over the temperature range of 0 to 55 degrees Celsius and include a 30-minute warm-up from ambient conditions. Typical and characteristic information provide useful information by giving non-warranted performance parameters. Typical refers to test data at the fiftieth percentile for a 25 degree Celsius room temperature. Characteristic information describes product information for parameters that are either not subject to variation, non-measurable, verifiable through functional pass/fail tests, or as a matter of routine not measured.
2. Adjacent channel desensitization applies to the wideband mode (1.25 MHz IF filter) and is defined as: 1 dB compression of tuned signal with interfering signal ±1.25 MHz from tuned signal.
3. Adjacent channel rejection applies to the narrowband mode (30 kHz IF filter) and is defined as: Suppression of interfering signal ±30 kHz from tuned signal.

GPS

The E7450B and E7452A systems have the ability to work with several types of GPS interfaces. The system is compatible with the communications protocols listed below. The physical interface is RS-232 with a DB9 connector.

Compatible protocols

- TAIP
- TSIP
- NMEA

Two different GPS receivers are available as options on the E7450B and E7452A systems. Option 200 adds a GPS receiver mounted internally to the E6450B or E6452A receiver, providing excellent portability and convenience. Option 210 adds a Trimble Placer GPS 455 receiver with dead reckoning (DR) for external connection to the system.

Option 200: internal GPS receiver¹

- 8 channel GPS receiver
- Mounted inside E6450B or E6452A enclosure
- SMB antenna connector
- Bulkhead mount antenna with cable
- Magnetic mount antenna with cable
- Differential compatible
- *Not* dead reckoning compatible

Option 210: external GPS receiver with DR

- Trimble Placer GPS 455 with dead reckoning
- Heading sensor
- Interconnect adapter
(to connect to the E6450B or E6452A receiver)
- Interconnect cables
- Bulkhead mount antenna with cable
- Magnetic mount antenna with cable
- Differential compatible

The E7450B and E7452A software include a virtual front panel for the GPS receiver. This window displays a bar graph with the individual satellite signal strengths, a text display of the GPS statistics and a map of location history. This map also displays the base station locations, names, and PN offsets.

External GPS receivers used with the E7450B and E7452A systems must output the GPS 1 pulse per second signal for CDMA measurements. To use this signal, a special adapter may be required. Options 211 and 212 are interconnect adapters for connection of certain Trimble GPS receivers. The table below lists several GPS receiver models and the associated interconnect requirements. For other models of external GPS receivers, consult an Agilent representative for adapter availability.

GPS receiver model	Interconnect requirement
Trimble Placer GPS/DR	Option 211
Trimble Placer GPS 455	Option 212
Trimble SveeSix	Straight-through RS-232 cable
Trimble Placer GPS 400	Straight-through RS-232 cable

If a GPS receiver is purchased from Agilent as an option to the system, all necessary interconnect parts are provided.

Differential GPS can be used with the E7450B and E7452A systems, provided the GPS receiver being used is differential compatible. Option 230 adds a differential GPS receiver to the system.

Option 230: differential GPS receiver

- Differential corrections, incorporated RDS-3000
- Magnetic mount antenna
- Interconnect cables

1. Systems with Option 200 do not support connection to external GPS receivers.

Computer hardware

The E7470A and E7472A systems require a PC. The minimum PC requirements are listed. If you wish to purchase a laptop computer with the system, Option 010 adds an HP Omnibook 3000 CTX model 4000.

Minimum PC requirements

- Pentium processor (clock rate \geq 120 MHz)
- Windows 95® or Windows NT® (4.0 or later)
- RS-232 (DB9) serial port
- 32 MB RAM
- 40 MB disk space for software installation
- 200 MB disk space recommended for data
- CD-ROM drive recommended
- 800 x 600 display resolution

Option 010 PC specifications

- Pentium processor (266 MHz)
- Windows 95
- 48 MB RAM
- 4 GB hard disk
- 20x CD-ROM drive
- Enhanced lithium ion battery pack
- 13.3 in - active matrix display
- 1024 x 768 display resolution

More information on the HP Omnibook can be found at www.hp.com.

Mapping software

MapInfo can be launched from within the Agilent E7450B and E7452A, providing transparent integration between mapping information and measurement data. In addition, the E7450B and E7452A can output data in ASCII format, allowing the user to import data into other applications (see data export section). MapInfo can be purchased with the system as Option 310, and if a laptop computer is ordered, the software will be installed on the laptop.

Portability accessories

The Agilent E7450B and E7452A are lightweight, portable systems. The following options are offered with the system:

Option 510: vehicle mounting kit

Brackets and screws for mounting an E6450B or E6452A digital receiver.

Option 530: briefcase carrier

For transporting an E7450B or E7452A system. System is not intended to be operated from within case. Dimensions: 17 $\frac{3}{4}$ in. x 14 in. x 5 in.

Training

Training is provided with the E7450B and E7452A systems. For training information, please consult our website at www.agilent.com/find/drive_test or contact your Agilent Technologies representative.

Warranty

One-year warranty on hardware components, and one year of application support is included with the Agilent E7450B and E7452A systems.

Related literature

<i>Agilent E7450A Brochure</i>	5965-7426E
<i>Agilent E7470A and E7472A Data Sheet</i>	5966-3851E
<i>Agilent E7460A Data Sheet</i>	5966-3850E
<i>Agilent E74XX Series Configuration Guide</i>	5966-2976E

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